**Exam Review**

***Disclaimer: The following is a review of the basic topics covered in this course. To prepare thoroughly for the exam, do not rely solely on this document. You will also need to review the course presentations, animations, tests, quizzes and textbook.***

**Unit1: Biochemistry**

1. Know the names and structures of biochemical monomers (monosaccharide, fatty acid, amino acid, nucleotide) and names and general structures of their polymers (di- and polysaccharides [starch, glycogen, cellulose], triglycerides and phospholipids [fats], peptides [proteins], DNA & RNA
2. Know the nutrient tests (Benedict’s, Lugol’s Iodine, Biuret, Sudan IV) and which specific biomolecules they detect.
3. Identify the different functional groups [hydroxyl, sulfhydryl, carboxyl, amino] and intra- & inter-molecular bonds [hydrogen bonds, ionic, linkages: ester, glycosidic (ether), peptide (amide), phosphodiester, disulphide] by name and structure.
4. Compare and contrast: hydrophilic, hydrophobic, amphipathic.
5. What is the difference between saturated and unsaturated fats?
6. Describe the four levels of structure in proteins.
7. What is an enzyme? Describe substrate, active site, allosteric site and competitive vs. non-competitive inhibition and feedback inhibition.
8. Describe how the following factors affect enzyme activity: temperature, pH, enzyme concentration, substrate concentration.
9. Describe the components of the fluid mosaic model of membranes.
10. Describe passive and active transport across the cell membrane, involving: simple diffusion, facilitated diffusion, channels, “pumps”, osmosis, active vs. passive transport, endo- vs. exocytosis, pino- vs. and phagocytosis.
11. Define isotonic, hypotonic, and hypertonic.
12. Know the names and functions of all cellular organelles.

**Unit 2: Molecular Genetics**

1. Compare and contrast the RNAs (t, r, m) and DNA on the basis of structures and functions.
2. What do we mean by 5’ and 3’? How does this relate to reading a DNA sequence?
3. How is DNA replicated? Describe the events and components of replication in order. Describe the differences between leading strand and lagging strand.
4. Know the purpose of the reagents and steps in the DNA extraction lab procedure.
5. What is transcription? Describe the events of transcription in order.
6. What is translation? Describe the events of transcription in order. What is the genetic code? What is a codon? anticodon? How do they relate to the amino acid sequence?
7. What are ribosomes? Describe their role in translation in detail.
8. What are the major post-transcriptional modifications in eukaryotes?
9. What are the major post-translational modifications in eukaryotes?
10. Compare and contrast introns and exons.
11. What is proofreading?
12. What are promoters and operators? How are they regulated?
13. Compare and contrast the lac and trp operons in bacteria.
14. What are the consequences of the following point mutations? base substitution (silent mutation, nonsense mutation), frameshift mutation (insertion, deletion).
15. List and describe the classes of large-scale chromosomal mutations.
16. Understand the basic strategy of gene cloning.
17. What are restriction endonucleases? Compare sticky ends and blunt ends.
18. What is ligase?
19. What is transformation? How is it done in the lab?
20. Be able to construct a labelled plasmid map from restriction digest information.
21. What is gel electrophoresis? Describe how it works.
22. Compare and contrast agarose and polyacrylamide gels.
23. What is PCR? Describe the steps involved.
24. How do you find the genetic sequence using the Sanger method?
25. What are: hybridization probes, microarrays, knockout mice, CRISP-Cas9?

**Unit 3: Homeostasis**

1. What is negative feedback? Give two biological examples.
2. What is positive feedback? Give two biological examples.
3. Explain the mechanisms of thermoregulation and osmoregulation in the human body.
4. What are the parts of the nephron? Where is it situated in the kidney? How does the fluid within the nephron change between filtration into the Bowman’s capsule through to movement into the ureter? Define and give examples of: filtration, reabsorption, secretion and excretion.
5. How are water levels controlled in the body?
6. Compare lipid-soluble (steroid) hormones with water-soluble (peptide) hormones.
7. What do the following hormones do: oxytocin, epinephrine, acetylcholine, ADH, insulin, glucagon, ACTH?
8. How is your blood glucose level affected by eating? Fasting?
9. What hormones control the blood concentrations of the following: glucose, calcium, sodium?
10. Where do we find, and what is the function of, the: hypothalamus, thyroid gland, adrenal gland, pituitary gland, mammary gland, testes and ovaries, pancreas?
11. How are the human male and female reproductive systems regulated?
12. Describe what the human body will do during short-term and long-term stress.
13. Draw the structure of a neuron. Where does it receive information/stimulation? How does the signal travel along the axon? What happens when the signal reaches the opposite end?
14. Describe the various stages of the action potential and synaptic transmission. What are the roles of: ligand-gated channels, voltage-gated channels, sodium-potassium ATPase pumps?
15. How is an action potential stimulated? Why is it referred to as “all or nothing”?
16. What is the source and function of myelin?
17. What are the components of a reflex arc?
18. Compare and contrast: CNS, PNS, ANS (sympathetic vs. parasympathetic).
19. What do hormone/neurotransmitter receptors & enzymes have in common?

**Unit 4: Metabolic Processes**

1. Compare and contrast: anabolic vs catabolic processes, aerobic vs anaerobic processes, endergonic vs. exergonic, endothermic vs. exothermic, electron donors vs. acceptors, substrate-level vs. oxidative phosphorylation.
2. Understand Gibb’s free energy and energy coupling.
3. Know the structure and names of the components of mitochondria and chloroplasts.
4. Understand the detailed functions, steps and cellular locations of the four “phases” of aerobic cellular respiration, including: glycolysis, Kreb’s cycle, electron transport chain, chemiosmosis, proton motive force and how this relates to the formation of ATP. Understand uncoupling in brown fat tissue.
5. Starting with glucose, create a flowchart for the compounds in aerobic and anaerobic cellular respiration and fermentation in yeast & human muscle, including the math of ATP production.
6. Describe the order in which your body would use carbohydrates, proteins and lipids as a source of energy and why. Know where amino acids, fatty acids and glycerol enter aerobic respiration.
7. Understand the importance of allosteric regulation of phosphofructokinase by AMP, ATP & citrate.
8. Understand the detailed functions, steps and cellular locations of the two “phases” of photosynthesis (light-dependent and light-independent reactions). This includes the source of oxygen and water, formation of carbon dioxide, photosystems, ETC, linear vs. cyclic pathways and Calvin cycle.
9. Understand carbon fixation, Rubisco and photorespiration.
10. Compare and contrast C3, C4 and CAM plants on the basis of the following adaptations: leaf anatomy, biochemistry, activities at various times of day, and biogeographical distribution.
11. Understand light response curves and the influence of carbon dioxide, oxygen and temperature (Gizmo).